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Title: Preliminary Interpretations from Fall 2018 Field Test at Ne’ot Hovav

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Preliminary Interpretations from Fall 2018 Field Test at Ne’ot Hovav

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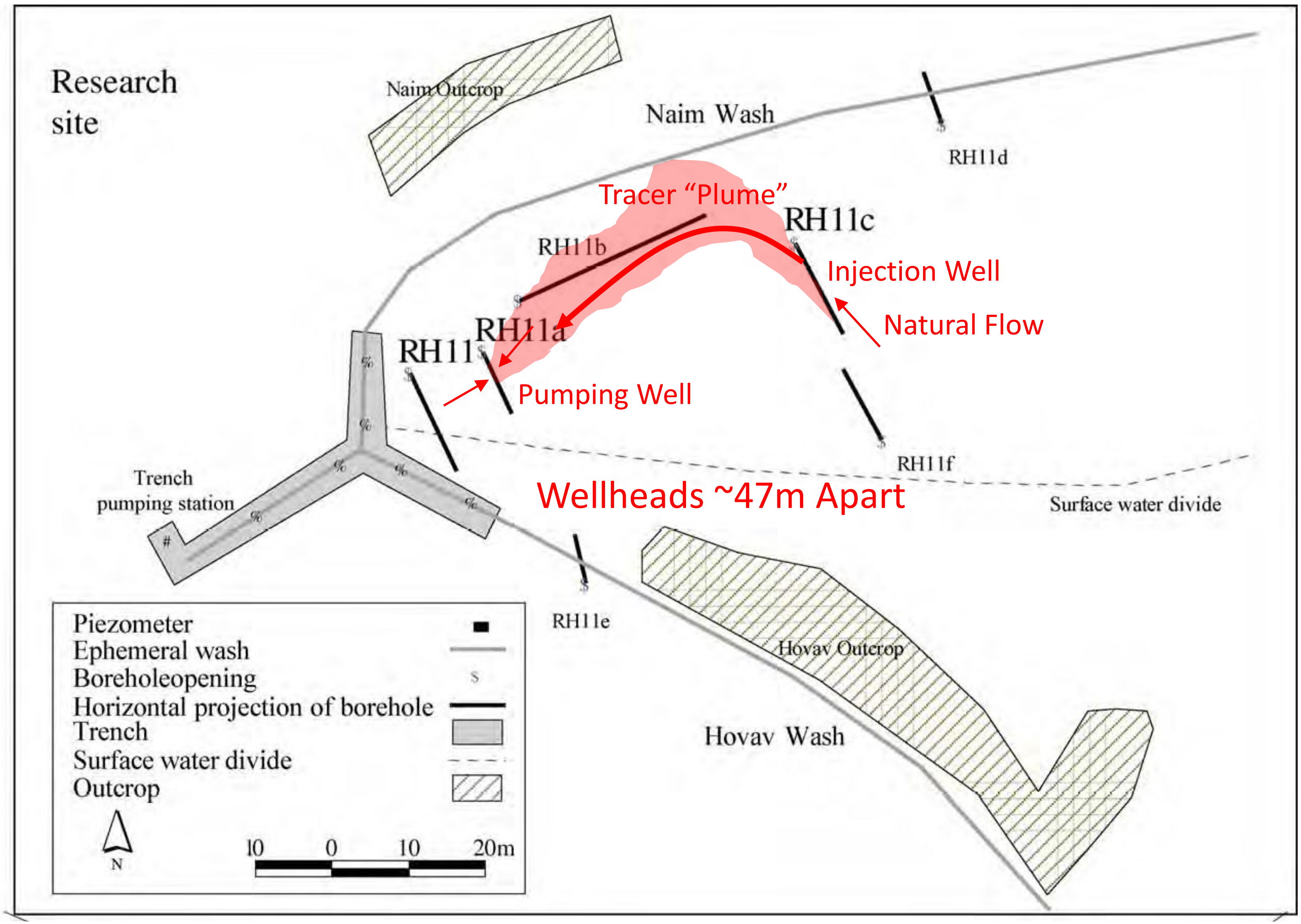
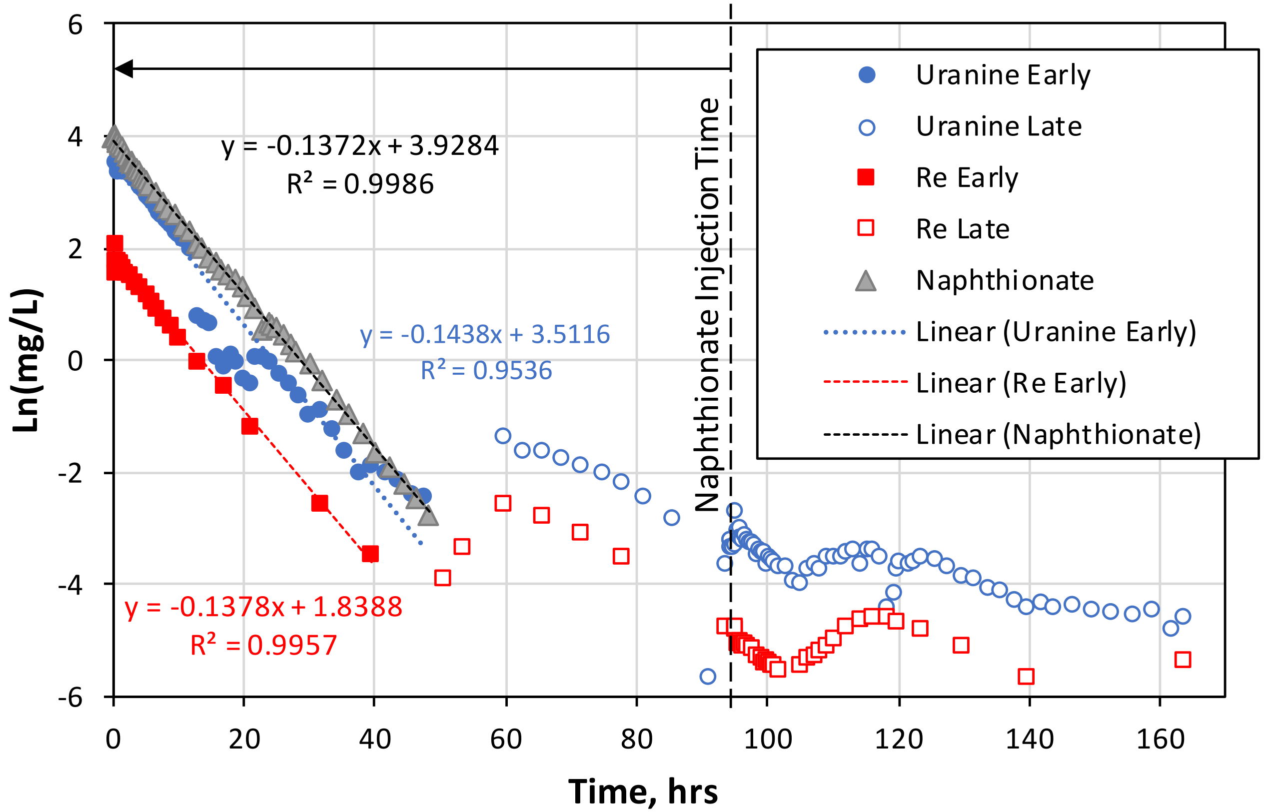
Presumed Flow Pathways Based on Previous Test Interpretations



Map from Kurtzman et al., 2005

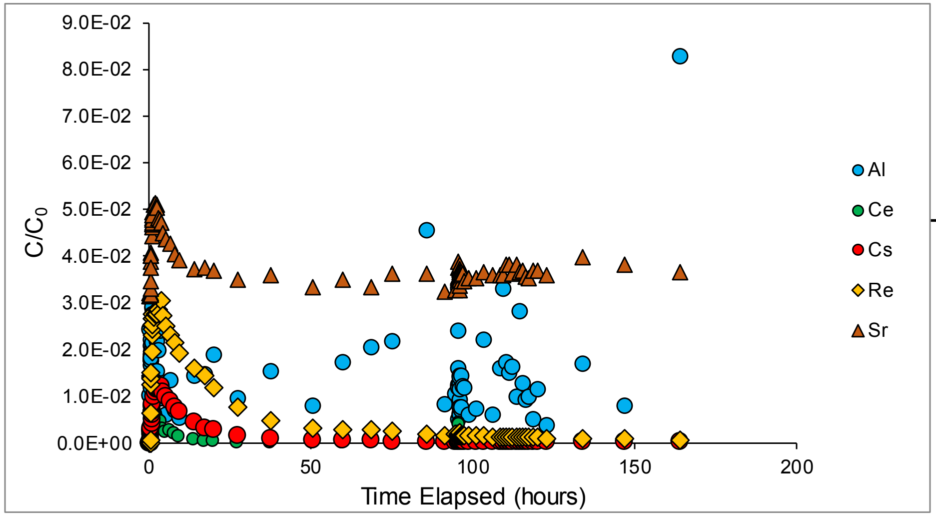
Injection Functions (Conservative Tracers)



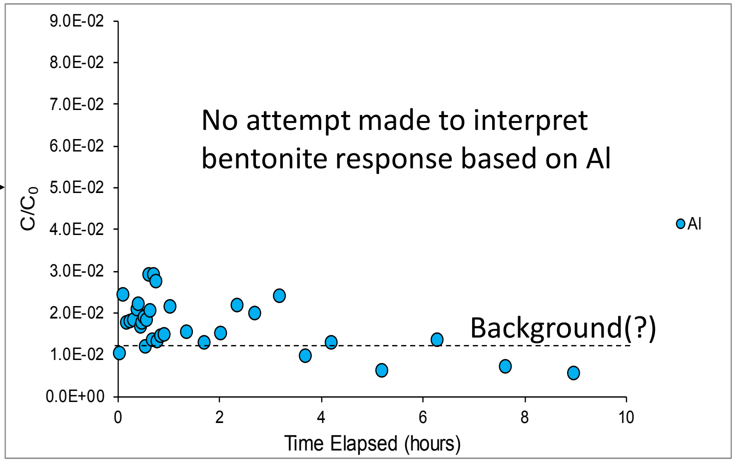
- All Declines are Nearly Identical over First 40+ Hours after Injection
- Implied Flushing Rate of Injection Well is (300 L)(0.14 hr^{-1}) = ~42 L/hr, which is ~9% of Pumping Rate (480 L/hr)
- No Apparent Change in Flow Conditions Near Injection Well During Test

Responses at Pumping Well

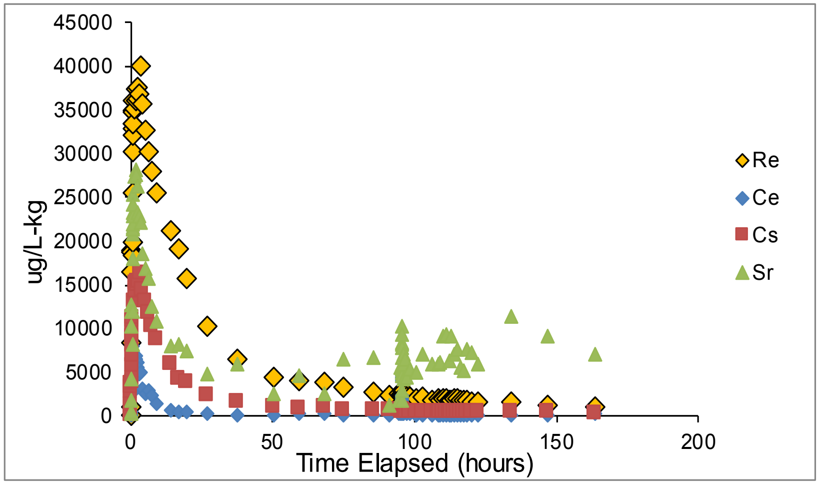
Emily's C/C_0 plot

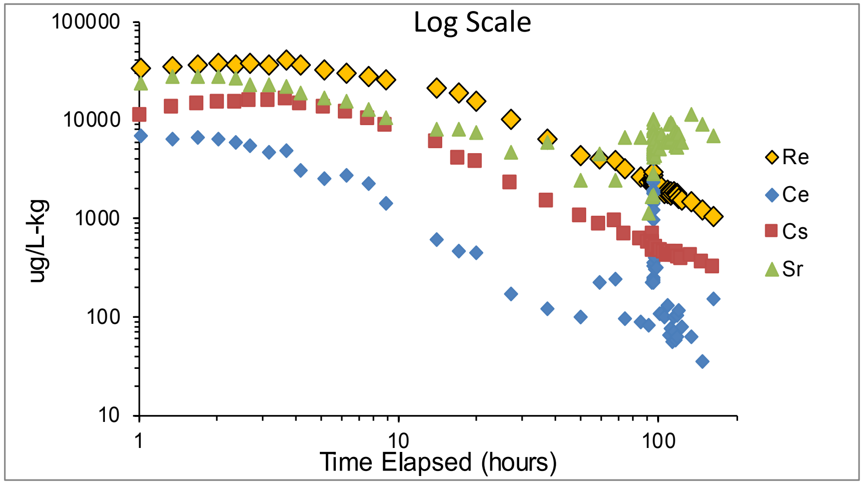


Al Only

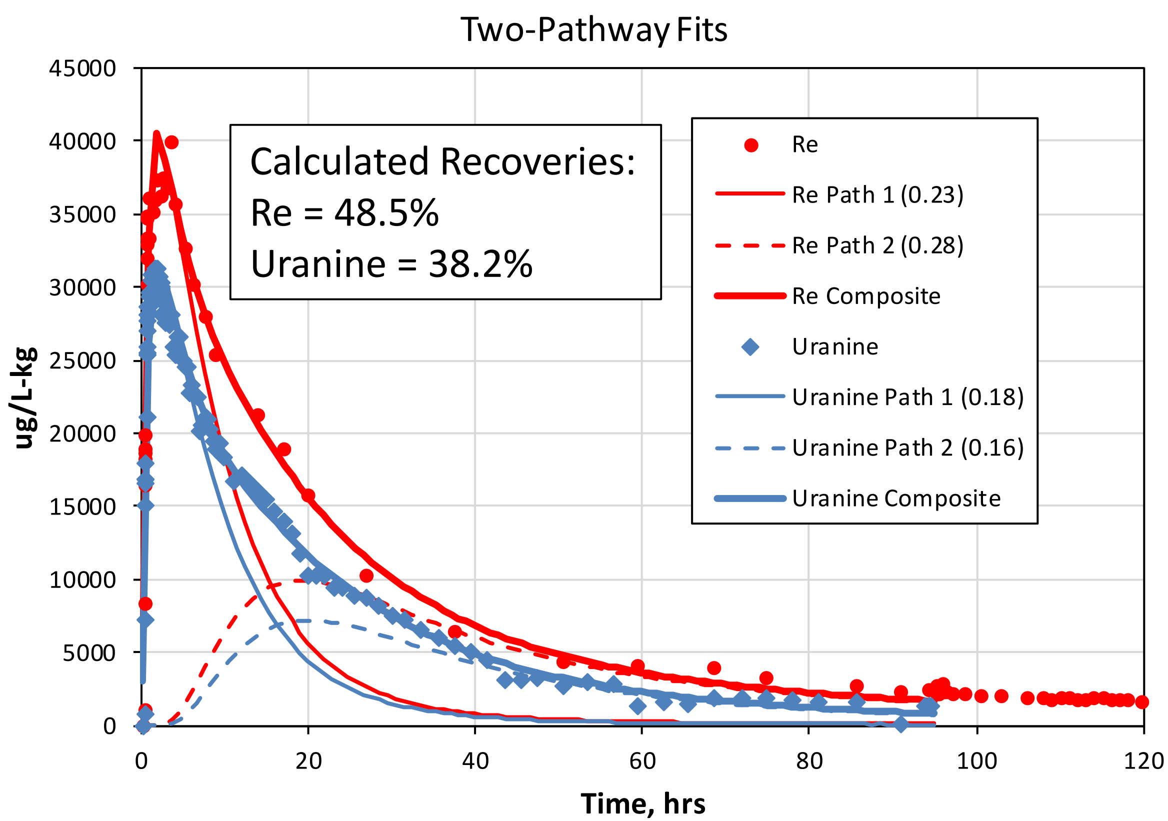


Normalizations to ug/L per kg injected (with most Sr background-subtracted)





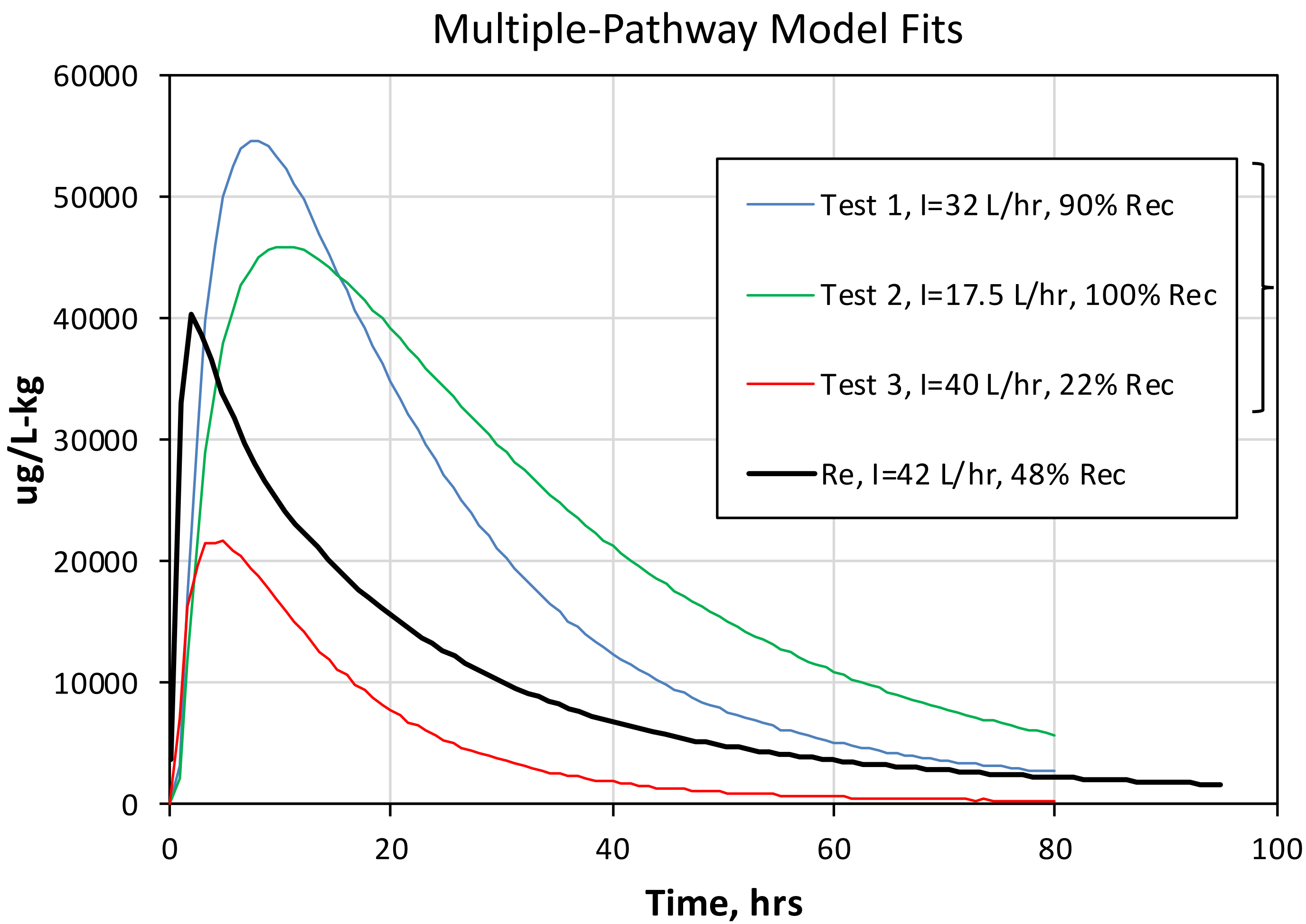
Re and Uranine at Pumping Well



- Normalizations based on injection masses, not (Inj. Conc.)(Inj. Volume)
- Despite differences in pathway mass fractions (due to different recoveries), deduced pathway transport parameters are very similar
- As in previous tests, ridiculously large dispersivities (small Peclet #s) are deduced

	Re Path 1	Re Path 2	Uranine Path 1	Uranine Path 2
Mass Fraction	0.23	0.28	0.18	0.16
Mean Time, hr	38	76	38	40
Peclet No.	0.012	0.8	0.012	1.8

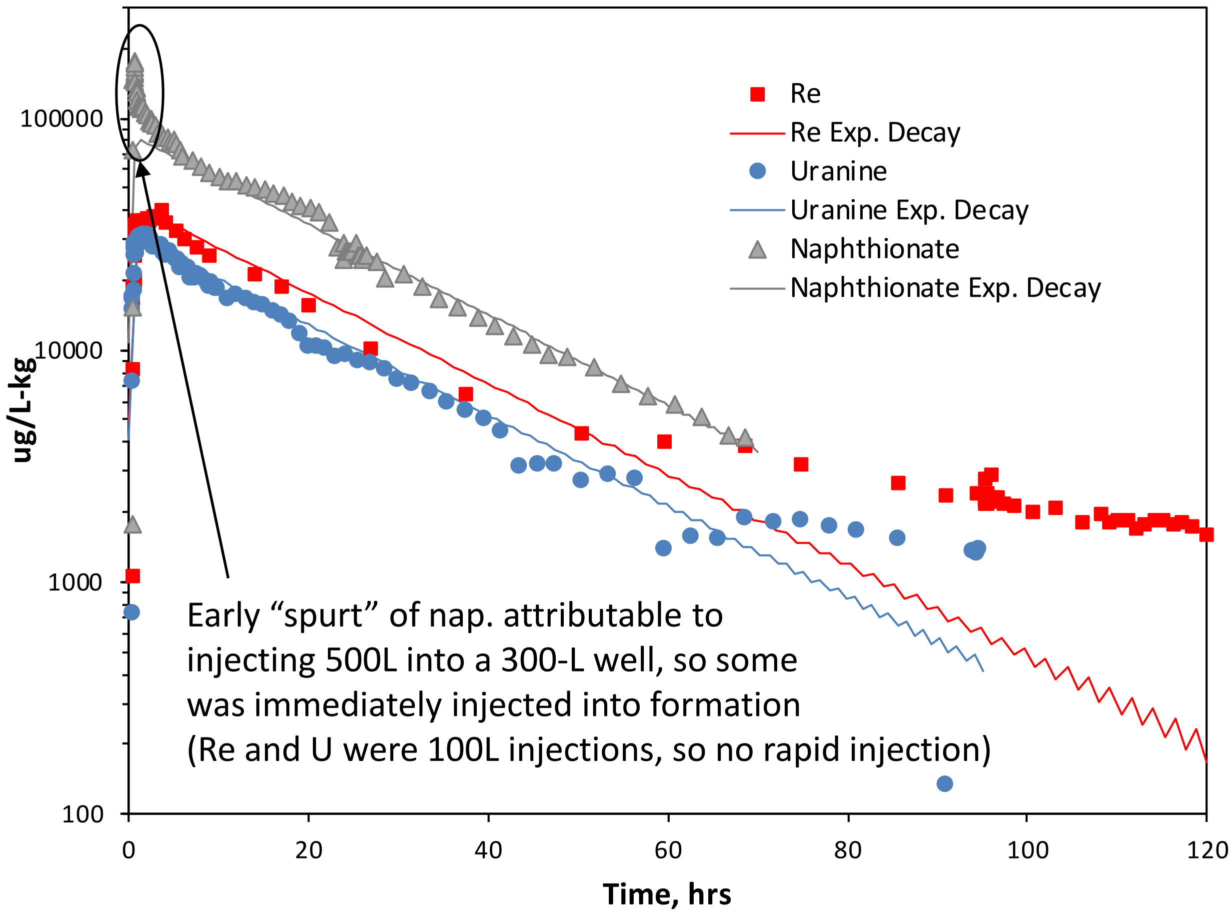
Re Comparison with Earlier Tests



Injection Rates in Earlier Tests should Be ~79% of These Based on New Injection Well Volume

While all responses are qualitatively similar, the 2018 test (Re) has earlier peak followed by almost perfect exponential decay

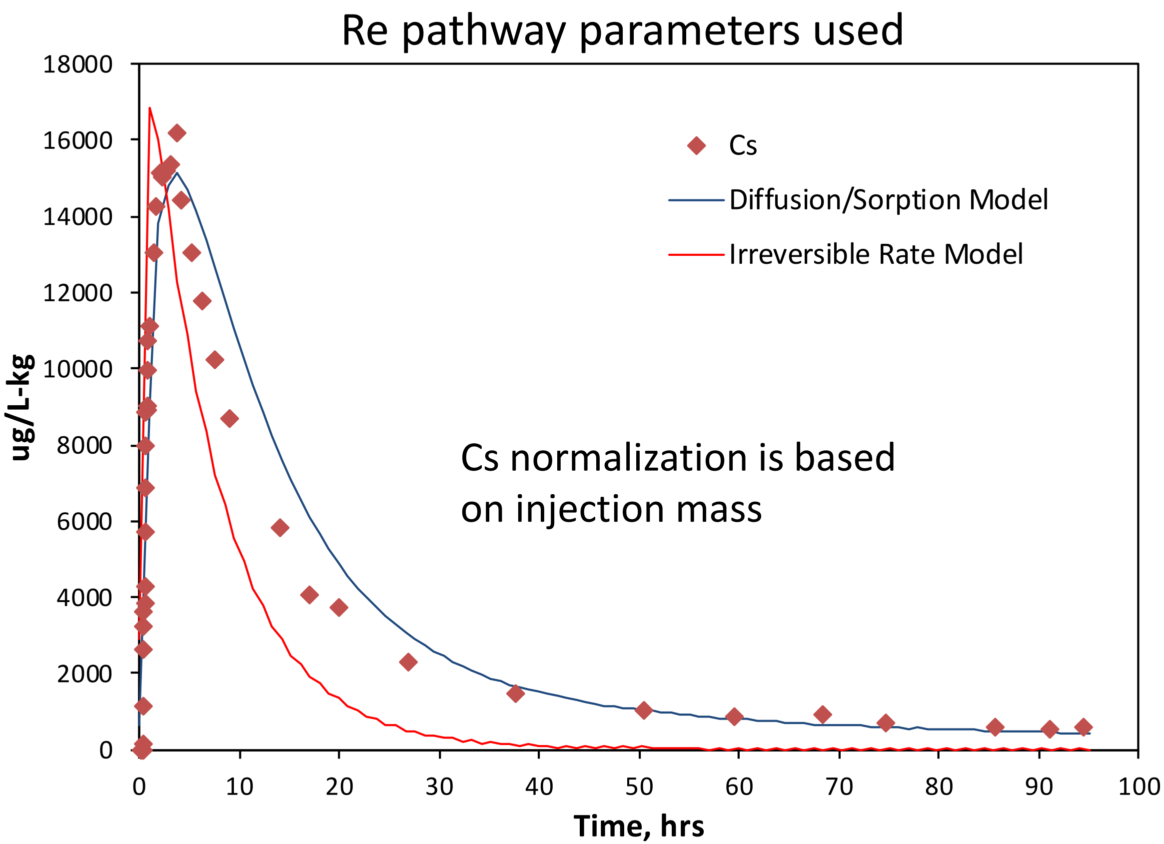
All 2018 Conservative Tracers follow Simple Exponential Decay (for first 60 hours) – this is merely an interesting academic exercise



- Naphtionate recovery is calculated as ~92% based on mass injected
- However, Nap recovery based on (Inj. Conc)(Inj. Volume) is ~39%, which is much closer to Re and Uranine
- Note that Re and Uranine recoveries calculated this way are about 55% and 45%, respectively (both somewhat higher than mass-based recoveries)

All responses are modeled here as an exponentially-decaying source with a decay constant of 0.045 hr^{-1} (vs. 0.14 hr^{-1} for injection well) and plug flow in the formation with a residence time of 0.1 to 0.3 hrs (trivial dispersion)

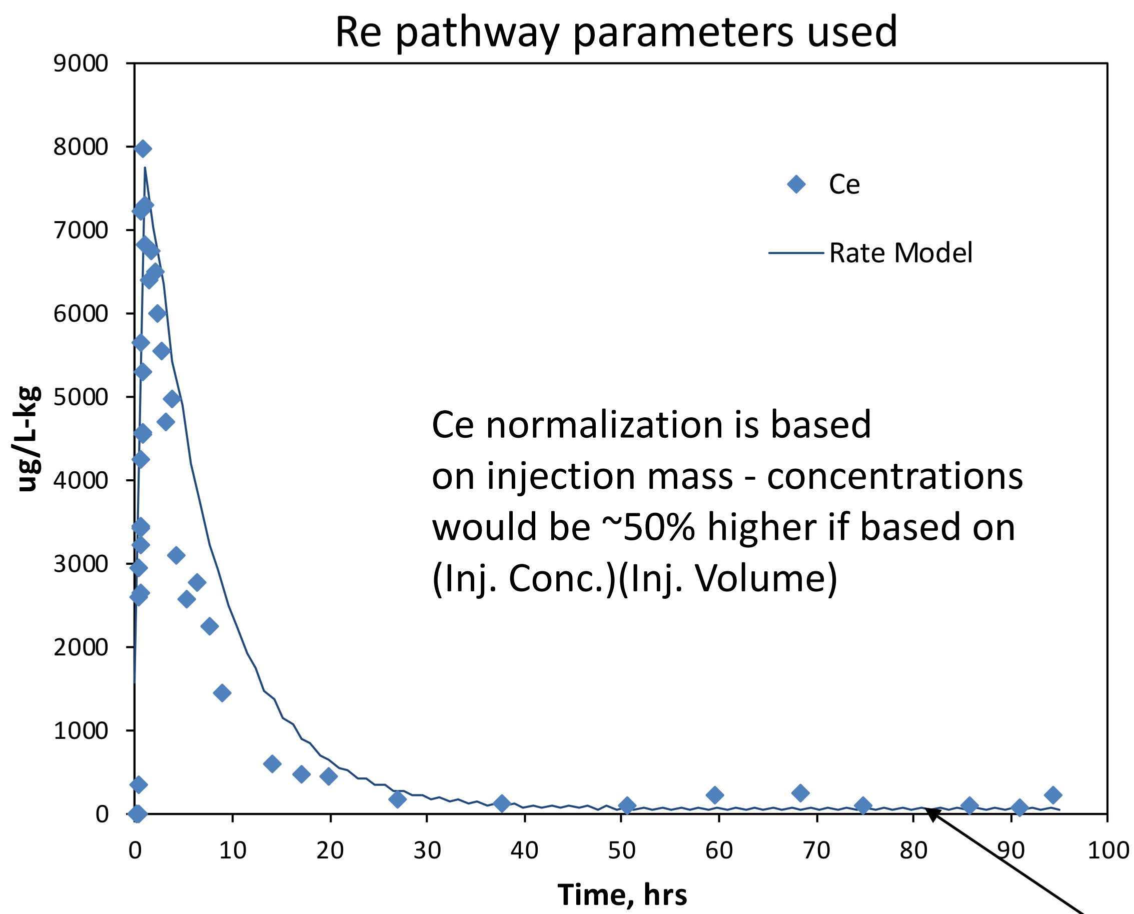
Cs Response Consistent with Diffusion/Sorption in Matrix



Note that these fits use only the first of the two pathways deduced from conservative tracers – the second pathway contributes <u>nothing</u> in either case because diffusion/sorption or first-order reaction depletes all Cs in second pathway

- Irreversible rate model is conventionally used for colloid filtration or to describe desorption from colloids (note that reversible rate, i.e., assuming some colloid resuspension, would provide better fit to tail)
- Tailing is consistent with diffusion and sorption in matrix (the latter is also consistent with fact that vast majority of injected Cs, 94%, was not colloid-borne)
- If we assume matrix porosity of 0.4 and fracture aperture of 0.5 cm, modeled Cs K_d value in matrix is ~225 ml/g
- Cs K_d value on chalk in laboratory was measured at >1000 ml/g (check units)
- This is considered good agreement given uncertainties

Ce Response Consistent with Colloid Filtration

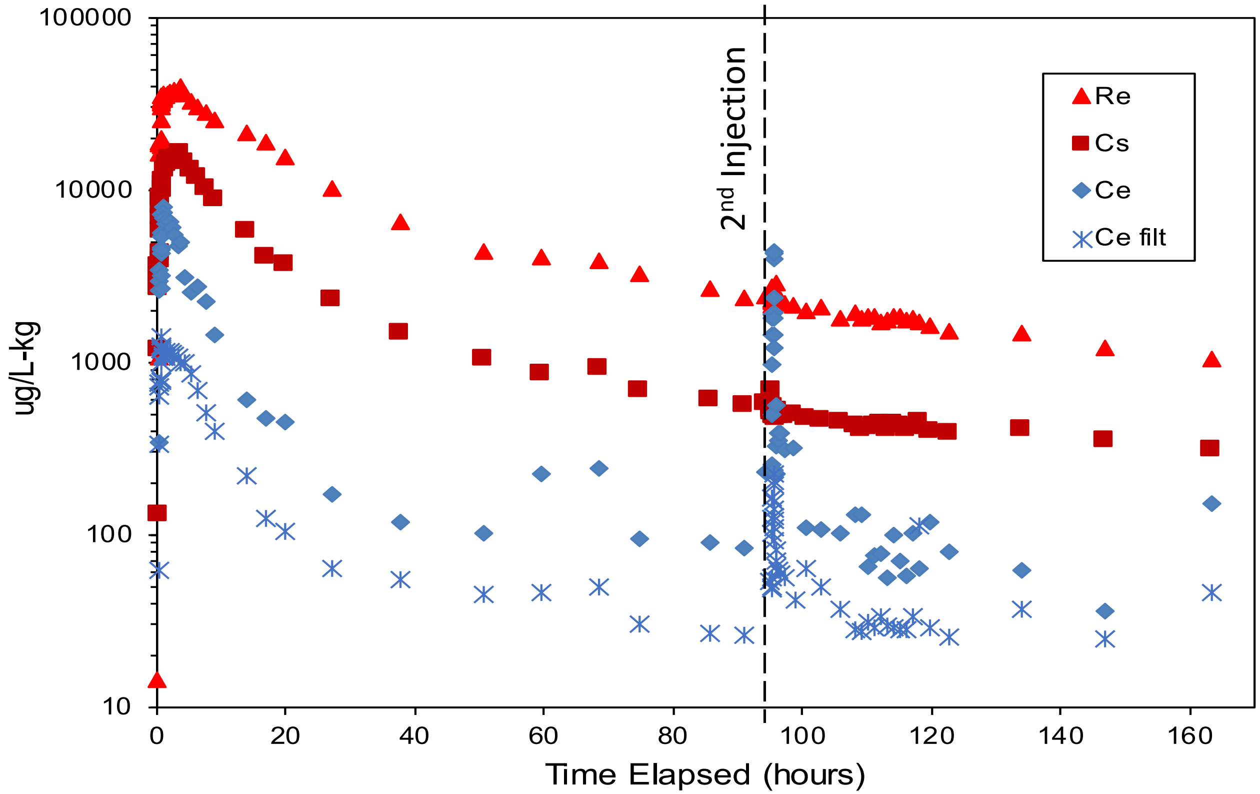


- Model assumes all Ce is colloidal (93% measured as colloidal in injection solution)
- Fitted first-order filtration rate constant is 9 hr^{-1} (very fast)
- Modeled rate constant would be somewhat smaller (but still fast) if concentrations were normalized to (Inj. Conc)(Inj. Volume)

Note that any diffusion/sorption in matrix will result in higher predicted tail – so such a model is rejected

As with Cs, the model uses only the first of the two pathways deduced from conservative tracers – the second pathway contributes <u>nothing</u> because first-order reaction depletes all Cs

Other Points to Consider



Ratio of filtered to total Ce is consistently larger than in injection solution

- Big jump in Ce after 2nd injection (low-ionic-strength water w/ naphtionate) is consistent with remobilization of filtered Ce-bearing colloids
- Lack of such a jump for Re and Cs is consistent with solute-dominated transport (also, little difference between filtered and total concentrations is consistent with this)
- The relatively consistent ratio of filtered to total Ce and the big jump in filtered Ce after 2nd injection suggests that Ce is transported mainly (perhaps exclusively) as colloids but some Ce almost immediately desorbs or dissolves after sample collection

Conclusions

- Conservative tracer transport was reasonably consistent with earlier tests between RH11c and RH11a
- No attempt to model bentonite colloids because of minimal elevation of Al concentrations over background
- Modeling confirms what we knew already for Cs and Ce
    - Cs transports as solute that sorbs in matrix (after diffusion into matrix)
    - Ce transports as colloid that is rapidly filtered
    - Sr not modeled, but qualitatively appears consistent with combination of colloid and solute transport